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THE JUNIPER WEBWORM.

(Dichomeris marginella Fabr.)

by H. Andison.
Dominion Entomological Branch, Victoria, B.C.

An infestation of Juniper webworm on Vancouver Island was first reported near Victoria in 1934. The infested trees consisted of several specimens of Irish Juniper, (**Juniperus communis** var. **hibernica**).

Again, in April, 1935 it was found in the city of Victoria attacking not only the **hibernica** variety but also the spiny juniper, (**Juniperus communis** var. **sibirica.**)

The Juniper family is a very large one and is quite extensively used in British Columbia landscaping. There are a great many species planted in this province and several native forms as well, upon which the webworm might become a serious pest. In view of the fact that this species is not well known to Canadian entomologists, a study of its habits and characters was undertaken, commencing in May, 1935.

Nature of Injury: The larval feeding appears to be confined to the foliage of the **Juniperus communis** varieties. The tiny larvae begin to feed on the upper surface of the small leaves, killing them and thereby weakening the tree. As the larvae develop, they spin a web and form communal nests. These nests made up of dead, brown-colored leaves and twigs enclosed in a tough silken web, contrast sharply with the green of the terminal growth. The nests often contain fifteen or more larvae and occur in sufficient numbers to so mar the appearance of the tree as to spoil its ornamental value.

Life History: There appears to be only one brood each year in the Victoria district. The caterpillars develop slowly and pass the winter as nearly full grown larvae, hibernating in the webbed-together foliage. The majority of the caterpillars reared in the insectary became active early in May and commenced feeding on the more or less dried leaves enclosed in the nest. They became full grown and pupated in numbers from the middle of May to the end of June. Pupation takes place in a whitish silken cocoon, made among partly eaten and webbed-together needles. The first moth emerged about the last week in May after a pupation period of 20 to 25 days. On account of the difference in size of the hibernating larvae the moths appear over a period of several weeks and continue to emerge until the first week in July; the majority, however, emerge about the middle of June.

Egg stage: Usually the eggs are deposited singly, rarely in pairs, and can be found in numbers during the third week in June. They are laid on the new terminal growth, each egg being deposited in the axis

formed by the stem and the leaf. The majority of the eggs were found on the inner base of the developing needles. Some are deposited on the shoots, from which the leaves arise, and on the stems.

The eggs, which are generally so well concealed in the axis of the needles that they cannot be distinguished without the aid of a lens, are distinctly barrel-shaped. When first deposited they are cream in color, measuring about 0.5 mm. to 0.6 mm. in length by 0.3 to 0.35 mm. in width. Another distinctive characteristic of the egg is the presence of shallow grooves, irregular in length, extending in a net-like pattern over its entire surface. After a period of about five days, the eggs commence to turn a pink color, gradually changing until finally they are a brick red. The incubation period is approximately 20 days. The oviposition period commences during the third week in June and larvae 0.5 mm. in length were found on July 10.

Larval Stage: After hatching, the larvae feed on the upper epidermis of the small leaves and about the end of July, when the larvae are 2 to 3 mm. in length, the webs are plainly visible. As the larvae mature, their gregarious habit becomes more pronounced and the foliage of the juniper is webbed together more compactly. The webs vary in length from 1 to 5 inches or longer. Such nests contain up to fifteen or more larvae.

The winter is passed in a partly grown condition, half-grown to almost full grown caterpillars hibernating in the silken nests. The larvae become active again early in May and if little or no green food is available they appear to develop readily on the dried foliage.

The mature larvae measure about 10 mm. in length and are reddish brown, striped longitudinally with narrow white lines. The head is a darker brown colour.

Pupal Stage: In the spring, when the overwintering larvae become mature, they commence to pupate. After the middle of May, pupae enclosed in whitish, silken cocoons can be found in numbers within the communal nests. The larvae continue to pupate over a period of several weeks, due to the fact that they vary considerably in size and age. All the overwintering larvae reared in cages kept in the insectary had pupated by the end of June. The pupal period of this species is from 20 to 35 days under insectary conditions. The pupal case is dark brown in colour, measuring about 7 mm. in length and 2 mm. in width at the anterior end.

Adult: The moth is an attractive species measuring 15 mm. across the expanded wings. The head is clothed with a dense covering of stiff white hairs. The palpi are long and heavily covered with long stiff hairs which are white above and brown below. Half way along the upper edge of the palpi a curved spine projects upwards. This spine is about half the length of the palpi. The thorax is covered with a patch

of coarse white hairs, similar to those on the head, with a smaller tuft of brown hairs at each side. The middle portion of the fore wings is brown with coppery reflections and the costal and lower margins are bordered with a conspicuous white stripe extending the full length of the wing. The hind wings are greyish white, heavily fringed, especially on the lower margin. The abdomen is light brown above with a few tufts of long white scales. Below, the body is light brown. The undersides of the hind wings are silvery white.

Control: No control experiments were conducted this season. We advised the owners of affected junipers to spray with lead arsenate at any time from the end of June to the middle of July. This was carried out but we have been unable yet to ascertain whether complete control was obtained. E. I. McDaniel (Mich. Agr. Exp. Sta., Quart. Bul. XVI, No. 4) recommends 3 lbs. of lead arsenate per 100 gals. of water, with 3 t 4 lbs. cheap flour as spreader.

Having regard to the life history of the insect, it is evident that spraying should be carried out before the young caterpillars protect themselves by forming a web. The ideal time for this would be just after the first eggs have hatched, and considerable pressure requires to be used to penetrate any webs which may have been formed. By applying the spray at an early date, the foliage will be coated with arsenate which should give protection over the remainder of the hatching period. If the spray is applied too late, great pressure is needed to penetrate the webbed-in feeding areas. In the fall, any nests that have been formed should be pruned out and destroyed.

AN ORTHOPTEROUS PEST OF APPLE TREES IN THE INTERIOR OF B. C.

By A. A. Dennys
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For a number of years, while occupied in the general practice of economic entomology as applied to orchard work, I had been completely mystified by a certain type of injury to young fruits. First of all, some seven years ago, my attention was attracted by finding young green peaches, at Creston in the Kootenay Lake area, which showed what looked like distinct toothmarks of a mouse. The peaches were only an inch in diameter and, as I thought, quite unattractive to man, beast, or insect. However, it was evident that something was religiously sampling a considerable number of the young peaches, taking a few bites out of each. In some cases the peaches affected were hanging upon the outer branches of the trees and the injury to them was in such a position that, if caused by a mouse, it would have required quite an acrobatic feat. There were the toothmarks, however, as plain as could be, and I searched during many fruitless hours for an insect capable of inflicting such toothlike marks. In the end, I persuaded myself that possibly bats must be the culprits—the only thing that would appear to be capable of sitting upon the fruit in such pendulous postures while inflicting the toothmarks.

During the past few years I again noticed the same familiar, rodent-like toothmarks on young fruit in June, this time, however, on young apples, both at Vernon and Salmon Arm. A few young prunes were also noticed to be injured in the same manner. In the case of the prunes, and also the peaches at Creston, the damage seemed more confined to a few clearly printed and deep-cut toothmarks, very similar to those made by mice in chewing things. The young apples, however, had, in many cases, more than mere toothmarks, as the culprits had actually eaten out small areas.

In June, 1934, while examining some sprayed apple trees early one morning, I suddenly found out the cause of all the injuries. There, sitting upon an apple, was a large grey cricket, right in the act of biting into the fruit! The mystery was solved at last. The culprit, identified by E. R. Buckell as **Cyphoderris monstrosa** Uhler, is one of the large crickets quite common in B.C., the males of which may be heard singing amongst the brush and upon trees in the summer evenings. By habit the cricket is a nocturnal feeder, hiding by day deep down in rubbish under boards and logs, or in cracks and cavities in the ground. Most of the feeding, I believe, is done in the earlier and warmer part

of the night. If one takes a flashlight and examines trees and shrubs after dark where these crickets abound, they may be seen sitting on the bark or twigs. They do not mind the light and are easily taken by placing an open jar below them, into which they fall at once when touched.

The accompanying photograph shows some of these crickets with young apples upon which they have been feeding. The marks caused by the sharp mandibles of these insects very much resemble the tooth-marks made by mice when they take a few bites out of a fruit.

Damage from these insects is mostly confined to orchards having sufficient cover around the trees in which the crickets can find suitable shelter in the daytime. It is doubtful whether arsenical sprays would prove of very practical value as the damage is seldom severe enough to warrant the heavy application that would be necessary.

THE INTRODUCTION AND PROPAGATION OF DIGONICHAETA SETIPENNIS FALL., A PARASITE OF THE EUROPEAN EARWIG.

By. C. W. Getzendaner

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Biological control is one of the newer tools of the economic entomologist for use in combating insect pests. Several outstanding instances of its successful application for the control of important economic insects are well known. This paper deals with the control of the European earwig (**Forficula auricularia** L.) by the use of the parasitic fly (**Digonichaeta setipennis** Fall.)

The Earwig

The European earwig was accidentally introduced into Washington and Oregon about 1909 and within a few years had gained a foothold in Seattle, Washington and Portland, Oregon. Various types of poisoned baits, traps, and other means of extermination have been devised and hundreds of thousands of dollars spent in attempting to eradicate or even control the earwig through compulsory and voluntary baiting and other means. The Bureau of Entomology and Plant Quarantine of the United States Department of Agriculture has developed a poisoned bait that gives better results than any previously used and will effectively reduce the earwig population in the baited area for any given season.

But, even with the methods of control at hand, the earwig has continued to spread from the original areas infested and now it may be found not only in the city but in the country and it is even infesting the woods. It is now gaining a foothold in eastern Oregon, eastern Washington and in western Idaho, and has recently been reported in Denver, Colorado.

The depredations of the earwig are far-reaching and affect small home flower and vegetable gardens as well as the large commercial plantings. Because of its nocturnal habits and ability to conceal itself so well during the day, its existence is often unknown and something else is blamed for the damage it does.

Earwigs not only destroy plants but destroy their usefulness. The beauty and charm of a flower or the delicacy of a fresh vegetable often have to vie with the repulsiveness of the earwigs they harbor. Cut flowers and earwigs have come to be associated to such an extent that the sale of flowers has fallen off. These losses are indirect and to check such infestations by baiting would be difficult.

All these factors make imperative some means of control that is not dependent upon regular concerted human attention. Biological control fulfills this need. Once an insect parasite is successfully established, it takes its toll of the host unceasingly, without effort on the part of man, and almost unnoticed.

Although parasites had previously been introduced into Oregon, it was not until the fall of 1931 that parasites were received at the Federal Laboratory at Puyallup, Washington. During the fall of 1931 about 121,000 earwigs were collected in Italy, England and France by agents of the Division of Foreign Parasite Introduction having headquarters at its laboratory in France, and shipped to Puyallup, Washington. From this importation of earwigs, about 2,800 specimens of the more important parasite, **Digonichaeta setipennis,** were obtained. These served as a start for the propagation of the parasite at the laboratory. Losses at first were heavy and parasitisation under artificial conditions slow, but as the needs and habits of the fly became better understood and better technique was worked out, production increased rapidly.

Method of Parasitization

Briefly, the method of parasitization now used is as follows: The parasites overwinter as puparia, brown in color and much like a grain of wheat in size and shape. Early in May the flies, mostly males at first, start emerging from these puparia and are put into mating cages for a few days. After mating, the females are transferred to oviposition cages for two or three weeks while they develop their eggs, after which they become quite active and anxious to find earwigs. They are then given proper light and heat and eggs are obtained by inserting into the cage with them a small cloth-covered wood block or cage containing a few live earwigs. The flies detect the presence of their host by odor and at once start ovipositing on the cloth above the earwigs. Each egg contains a fully developed larva or maggot about one-sixty-fourth of an inch in length inclosed in a thin skin or chorion which splits within a few seconds after being laid and releases the larva. This maggot has no eyes and locates its host by odor, alternately standing on its tail and waving its head about in an effort to pick up the odor, then dropping down and crawling for a short distance. When it detects the presence of the earwig its actions become more rapid.

When the cloth block contains a number of eggs and larvae, it is removed from the cage and earwigs whose activity has been reduced by ether are then individually hand-parasitized by picking each earwig up with a pair of forceps and holding it within reach of the active larva. The larva immediately clings to the earwig and crawls very rapidly until it comes to the soft membrane at the base of the legs or wings, about the

neck, or even between the segments of the abdomen, where it starts burrowing in at once. About 2,000 earwigs per person per day can be parasitized in this manner. If a greater number of parasitized earwigs is desired, at a sacrifice of the assurance that each earwig will have one parasite, then the number of larvae on the block is estimated and about the same number of anaesthetized earwigs spread over the larvae, covered with a glass dish and shaken lightly to aid distribution. By this method, twelve to fifteen thousand earwigs may be parasitized per day.

By the time the earwigs have recovered from the anaesthetic (ether) the parasites have usually completed their entrance. They do not go entirely in at this time, but stop with the hind end protruding slightly, leaving their spiracles exposed to the air. In the early stages the parasites feed only on the body fluid of their hosts, consequently the earwigs eat and digest their food in a normal manner. When almost full grown, the larvae detach themselves and float free inside the earwigs while feeding for a short time on the internal organs, then emerge as white maggots about one-fourth inch in length. They then burrow a short distance into the soil to shorten and harden into puparia, thus completing the life cycle. The earwigs live for only a few days after the maggots come out, and eat no food. Parasitized female earwigs never produce eggs.

Habits of the Fly

In the laboratory 15 percent of these first-generation puparia emerge in July and August as second-generation flies and about 5 percent of the puparia from these flies produce a third generation. Each fly lays from 300 to 500 eggs. The potential increase of the fly in a year is about 400 times as great as that of the earwig. That is, 10 female earwigs are capable of producing 600 offspring in a year while 10 female flies can produce about 242,000 in a year.

From what is known of the habits of the fly and of others in the same family of parasitic flies it is very unlikely that it will ever become troublesome in the house, even when it becomes abundant in nature. The adult fly feeds sparingly upon the nectar of certain flowers and is not attracted to cooking or other domestic odors.

In nature the adult females, when ready to lay, seek the haunts of the host and lay their eggs as close as possible to the hiding place of the earwigs so that the little maggots can get to them or will find them as they come out at night for food. The flies may be seen late in the afternoon running about over the bark of a tree, sticking their heads into every small crevice, or crawling into larger ones and dropping an egg or two where ever they pick up the earwig scent. The larvae, after hatching, can live for about 36 hours without the host.

Liberations

In the spring of 1934, about one-third of the puparia which had been reared the year before and overwintered at the laboratory were sent to the State of California to be propagated there. From the remainder, about 29,000 earwigs were hand parasitized from first generation flies and about 53,000 from the second-generation during the summer. From this stock, two experimental colonies of parasitized earwigs were liberated in the fall and a colony of puparia in the winter. In 1935, about 80,000 earwigs were parasitized from first-generation flies and 15,000 from the second generation. Fourteen additional liberations were made, all consisting of mated females that had been held at the laboratory until ready to oviposit. The parasites have now been liberated at Bellingham, Everett, Vashon Island, Puyallup, the laboratory, Roy, Castle Rock, Kalama, Amboy, Cathlamet, Naselle, South Bend, Hoquiam, Yakima, Walla Walla, and Pullman, Washington and Moscow, Idaho. These experimental colonies are for the purpose of determining the ability of the parasite to become established, its rate of distribution, and its effect upon the earwig.

Recoveries

In order to determine the presence of the parasite in the field, earwig hiding blocks or traps are put out at each colony at the point of liberation and at various points surrounding it. Each earwig trap has a parasite trap attached to the lower end to catch larvae as they issue from the earwigs and drop down to pupate. The presence of puparia then, in a trap indicates that the parasites have spread to that place. If percentage of parasitization is desired, the earwigs are collected from the traps and kept at the laboratory until their parasites have issued.

At this writing (November, 1935) either collections of earwigs or examinations of traps, or both, have been made at 9 colonies and parasites have been recovered from 6: Puyallup, the laboratory, Vashon Island, Roy, Everett, and Yakima. Seven puparia were found at one time in a trap on Vashon Island that had only 23 earwigs in it at the time of examination and six in a trap at Puyallup with 45 earwigs in it. In Puyallup the parasites were found to have spread at least two blocks to the north, within a year after liberation.

Conclusion

When parasites are transported from their native home into a new environment, reared and liberated in lesser numbers than occur in nature, they have many adverse factors with which to contend and it is

usually several years before they have become sufficiently abundant to be found. Often they are not recovered for many years and frequently they do not take hold at all. In view of this it is very gratifying that so many recoveries have been made of this earwig parasite within a year from the time of its liberation. Its successful establishment seems certain.

Summary

The European earwig (**Forficula auricularia** L.) has become an important economic pest and because of its wide distribution and large list of food plants, it is difficult to control by artificial means. Biological control is the logical means to hold this pest in check. **Digonichaeta setipennis** Fall., a parasite of the earwig in Europe, was imported in the fall of 1931 and from this stock, rearing methods as described have been worked out and large numbers propagated. Experimental liberations have been made and the parasite has been recovered within a year afterward. The results are encouraging for this parasite.

THE STATUS OF THE GLADIOLUS THRIPS IN BRITISH COLUMBIA.

By R. Glendenning,
Dominion Entomological Branch, Agassiz, B.C.

As a result of the serious damage caused by the gladiolus thrips in eastern Canada and other parts of North America, Regulation No. 10 (Domestic) was passed in March 1932, under the Destructive Insect and Pest Act, prohibiting the importation of gladiolus corms into this Province.

At that time no reports of the presence of this thrips had been recorded for British Columbia, and inspections of commercial plantations by officers of the Dominion Entomological Branch all over the province failed to show its presence. Similar inspections in 1933, again confined to commercial plantations, showed these to be free from thrips.

However, in the late summer of that year, material was brought to Mr. H. F. Olds, at the Vancouver Plant Inspection Office, from private gardens in Vancouver which, on submittal to Dr. J. B. Steinweiden, were determined as **Taeniothrips gladioli** M. and S., now known to be **T. simplex** Morr.

Scouting, performed as a result of this discovery, led to the location of three infested gardens in Vancouver. The sources of the infestations were investigated but without definite results. One party claimed that he had had the corms for many years, while a second had purchased his corms from two commercial growers on Lulu Island, near Vancouver. An inspection of these plantations by Mr. Olds and myself failed to show the presence of any gladiolus thrips. The origin of the outbreak in British Columbia has not been determined.

In 1934, a further outbreak was reported from South Westminster where several dozen gladioli were found to be heavily infested and to be completely spoiled by this pest. This outbreak was traced to a nearby small grower, whose entire stock of several hundred gladioli were entirely destroyed by the thrips.

Later in 1934 another infested commercial plantation was located at Sardis, some sixty miles from Vancouver. Complete destruction of many hundreds of gladioli had again taken place, and it was determined that some trouble had been noticed but not reported in 1933. The source of the infestation was traced to corms received from a private garden in Vancouver during the autumn of 1932. No thrips were found in gardens in the surrounding districts, even when the corms had been purchased from this grower.

In view of these infestations, and the undoubted fact that the thrips occurred in many other small gardens in Vancouver and district that

it was impossible to check up on, the order prohibiting the importation of gladioli into the Province was rescinded in May 1934.

At the request of Mr. A. G. Dustan of the Entomological Branch at Ottawa, and with the consent of the Dominion Entomologist, it was decided to test the ability of this insect to overwinter out of doors in the (often) mild winters of the Pacific slope.

In 1933, therefore, soil emergence cages were placed out in May in two infested gardens in Vancouver. In the first garden, the grower had pulled his gladioli in the autumn and burned them, so the cages were set out over the infested soil of the beds. In the second case, the owner had thrown the infested stalks and corms out onto waste land at the back of his garden, thus providing ideal conditions for our experiments, if not conforming to good garden practice. The cages in this case were placed on the pile of gladiolus refuse. The winter of 1932-33 was a mild winter, a green winter in fact, almost without frost or snow. However, weekly inspections by Mr. Olds and myself failed to obtain any gladiolus thrips from the vials in the cages, and in neither case did any infestation appear on gladioli growing in those or adjacent gardens; so that no overwintering out of doors appeared to have taken place.

In order to duplicate this work, and to make doubly sure, the experiment was repeated in 1934 in the badly infested commercial plantation at Sardis. In this case, the condition for overwintering were even more favourable than those of the previous year in Vancouver. Deep snow covered the ground during the short cold spell experienced, and the earth was at no time frozen during the entire winter. In addition to this, the owner, through illness, did not even dig his infested corms, and the entire lot passed the winter in the soil, in a weedy garden, and appeared as volunteers in the spring of 1934.

Cages were placed out in May, but frequent inspections of both cages and volunteer gladioli failed to show any gladiolus thrips. A second plantation, located about 300 yards distant, remained uninfested both in 1933 and 1934.

It would appear, therefore, that this pest definitely cannot overwinter out of doors in British Columbia, even under the most favourable weather conditions, and this is borne out by the fact recorded by Herrick and Shaw that, although they may overwinter on volunteer gladioli in California, they are killed by a temperature of 37 degrees Fahrenheit.

During the course of this inspection work, many species of thrips were found on gladioli. These were determined by Dr. Steinweiden as **Taeniothrips vulgatissimus** (Hal.), **T. atratus** (Hal.), **Thrips madroni** Moult., **Frankliniella californica** Moult., and **Aeolothrips fasciatus** (Linn). They all appeared to be pollen feeders and harmless, except **T. atratus.** This species was found on several occasions abrading the epidermis of the petals of lilac-coloured varieties, and to some extent damaging their beauty.

STUDIES ON THE RATE OF TICK FEEDING IN RELATION TO DISEASE

By J. D. Gregson
Kamloops, B.C.

A Study of Host Tissues in Relation to Varying Feeding Rates of Individual Ticks

General Discussion of Tick Paralysis

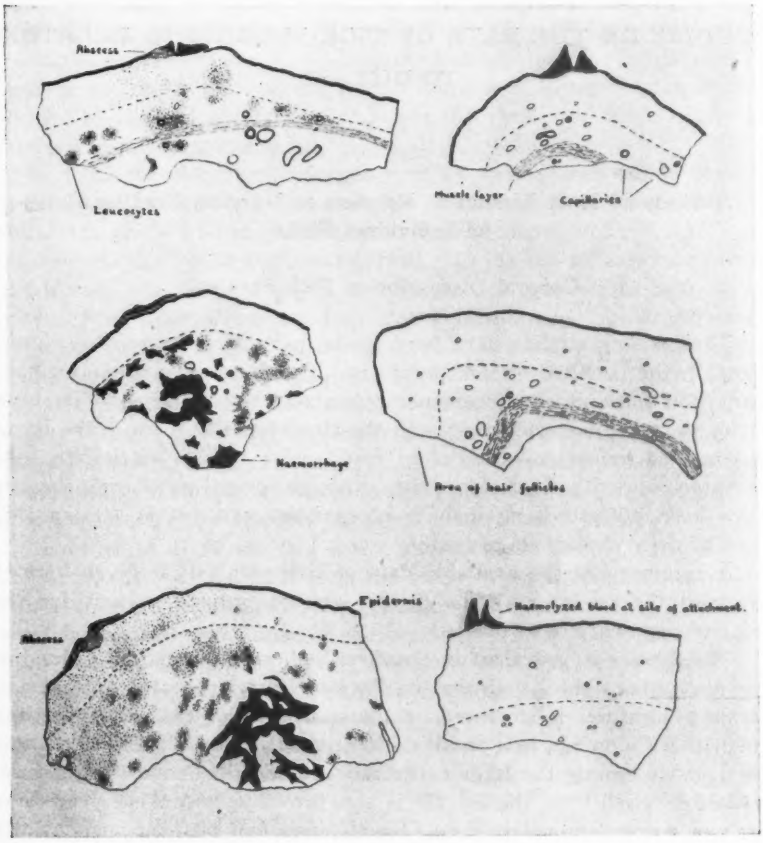
The ensuing studies have been made in an attempt to throw more light on the problem of tick paralysis. This disease is produced by a variety of ticks and its occurrence appears to be world-wide. Its mysterious nature, its seriousness, and the elusiveness of a causative factor has enticed numerous workers to spend more than a passing thought in connection with its etiology, but, although several conflicting theories have been advanced, no definite conclusions can yet be drawn that satisfactorily explain its cause.

A summary of the available data of tick paralysis is given here to acquaint the reader with the disease and to provide a basis for the experiments that are to follow.

The disease is prevalent in Southern Alberta and British Columbia, and throughout the Northwestern Rocky Mountain States of America. In these localities it is caused by the spotted fever tick, **D. andersoni.** In British Columbia, tick paralysis has attracted considerable attention, particularly among the large cattle ranches. Eight human deaths have to date resulted from the disease in this province, and every year there are minor cases among children. Sheep, dogs, and cattle are particularly susceptible to the tick, recent paralysis outbreaks in individual cattle ranches having involved, on two occasions, a hundred, and two hundred animals with a respective mortality of sixty, and thirteen percent.

Tick paralysis is prevalent in Australia and South Africa, proving a "veritable menace" to sheep farmers in many parts. The causative ticks in these countries are species of **Ixodes.**

Etiology: Tick paralysis may be produced in an animal by a single tick. The symptoms appear only when the tick has been engorging for about seven days and is nearing repletion. The onset is sudden and is characterized by a wobbly gait, and acute ascending motor paralysis. Pulse and breathing are rapid, there is slight glandular disturbance, and pain is absent. Death usually occurs in twenty-four to sixty hours from paralysis of the thoracic organs. If the causative tick is removed during paralysis there is rapid and complete recovery of the patient, normality



usually being attained in four to twenty-four hours, depending upon the seriousness of the disease. Exceptions to these observations are instanced in the case of a B.C. man, when recovery lasted over the period of three months, and in South African sheep which remain in a weakened condition for many weeks. There is considerable controversy as to whether an animal can be immunized against the disease. The writer has noted many instances where it has been impossible to induce paralysis even in young lambs with as many as a dozen rapidly feeding ticks.

The facts of rapid recovery negative necropsy findings, and negative inoculation tests point to the theory that a tick-secreted toxin is responsible for the paralytic symptoms. This is strengthened by experiments that have been performed in Australia in which it was found that an injection of crushed salivary glands from two and a half ticks proved to be the minimum lethal dose for the mouse. Opposing this

theory are the facts that the latter experiment has not been duplicated in B.C. by glands from as many as seven ticks, dissected in vivo or while frozen, and injected intravenously, subcutaneously, and intraspinally into mice, dogs, and sheep; that many ticks may feed upon an animal with no ill effect on the part of the host—or one tick may cause paralysis; and that a bacterial disease, similar in symptoms to paralysis, is produced in the moose by a closely allied tick.

Such is the present state of data on tick paralysis. It must be borne in mind, however, that owing to the wide distribution of this disease it is quite possible that the variations appearing in different countries, and even in the same provinces or states, are due to more than one type of disease. If this is true, then much of the confusing and conflicting data may be accounted for.

Variations in the Rate of Feeding of Adult Ticks and Relation of Such to Paralysis

Tick paralysis is generally thought to be due to a rapid injection of a salivary toxin by the tick into its host. This condition would logically accompany any rapid feeding on the part of the tick. Paralysis in B.C. is produced only by fast-feeding ticks that drop at the end of seven to eight days.

Attacking the problem from this end, the writer has endeavoured to discover the conditions that are conducive to rapid feeding of the tick.

It must first be noted that variations in the rate of tick feeding may be divided into two groups; an individual variation, present among certain ticks, and a general seasonal variation in which all ticks are affected. In the first case, a series of ticks of common origin, feeding under apparently identical conditions, will often show a variation in feeding period from seven to eighteen days.

In the second, it is noted that all ticks will feed readily in the spring months over an average period of about nine days, but towards the fall and during the winter months, although apparently willing to engorge, they exhibit a striking inability to do so.

It remains to be seen if there is any relationship between these two types of feeding phenomena. In the folowing experiment the writer will confine his studies to the first problem.

A Study of Host Tissues in Relation to Varying Feeding Rates of Individual Ticks

On June 11, 1935, a four-month old lamb was infested with twenty-eight pairs of adult **D. andersoni** ticks. These ticks were placed in groups of eight over the following areas of grease-free and closely-clipped wool and were covered by gauze infesting cages.

A. Directly behind the base of left ear.
B. Over left shoulder.
C. To right of spine in lumbar region.
D. To left of spine in pelvic region.
E. On right flank.
F. On right side of belly.
G. On scrotum.

By June 17th, the following engorging female ticks were in the indicated stages of repletion. (Ticks that had failed to attach during the first day were dessicated by the sun.)

A. 1 tick ½ replete.
B. 3 ticks ½ replete, 1, ½ replete.
C. 3 ticks ½ replete, 1 dropped replete.
D. 3 ticks ½ replete.
E. 3 ticks ½ replete.
F. 3 ticks ½ replete, 1, ½ replete.
G. 3 ticks ½ replete, 1 dropped replete.

These ticks were all of the same stock—a series of adults that were collected two months previously by dragging in a single area near Kamloops. They all commenced feeding on the same host at the same date, and were consequently under the same weather conditions. Each infested piece of skin was approximately 1 square inch in area, thus allowing the ticks of each group as little variation in skin structure as possible. Yet in spite of these conditions, similar for each tick, there appeared a great difference in their feeding rates, as shown above.

Immediately after repletion of two of the ticks (group C & G), the host was chloroformed. Pieces of skin ¼ inch deep and ½ inch square were incised around each tick, and, with the latter still attached, were placed in Bouin's fixative. To effect a rapid penetration of the fluid the dorsal integument of each tick was removed. The entire operation was completed as rapidly as possible, after which the animal was killed. Except for the two replete ticks that had previously detached themselves, not one of the parasites released its hold during the whole of the somewhat drastic procedure. All specimens were left in Bouin's for eighteen hours; removed to fifty percent alcohol for one hour; to sixty-five percent for six hours, and stored indefinitely in seventy-five percent.

A series of sections were made from the above-mentioned tissues. Where possible, these sections were taken through the site of attachment of the tick. Efforts to preserve the mouth-parts within the tissues were unsuccessful, due to their chitinous nature, but the depth of penetration could clearly be seen on certain slides, and was marked by a surrounding scab of dried blood. Very little mechanical disturbance appeared to result from the tick's feeding, the mouth-parts rarely penetrating beyond the epidermal layer.

Host tissue below fast-feeding ticks:

Sections dealt with here were made from the skin below two ticks that were replete at the end of seven days (groups C & G) and from tissues below a two-thirds replete tick (group E). All three series, being pathologically similar, will be described collectively.

The site of attachment of the parasite is surrounded by an area of dried haemolysed blood. Beneath this scab, in two of the three series, a small pocket of pus was present, representing probably a secondary infection. The whole of the dermis presented a picture of acute inflammation. The blood vessels and capillaries were tremendously dilated, and in two tissues had ruptured to form haemorrhagic areas of haemolysed blood. An edema was present throughout the tissue, filling lymph spaces with a thick transudate. Surrounding every blood vessel, and extending into the corium towards the tick, there appeared a vast collection of leucocytes. These foci consisted mainly of polymorphonuclears and fibroblasts, but contained a large percentage of eosinophiles, lymphocytes, and histocytes. In no instance could red blood cells be discovered, other than within certain of the unruptured capillaries. It

is believed by the writer that this whole area must be saturated with haemolysed blood, but no positive test for haemoglobin (Benzidene reaction) could be obtained outside of the haemorrhage to substantiate this probability.

Host tissue below slow-feeding ticks:

These three sections were taken from areas within half an inch from the above-mentioned ones. In each case the tick had only reached a semi-replete stage at the time the tissue was fixed. Histological examinations of sections through these areas showed that little change had taken place as a result of the tick. Edema and inflammatory processes were practically absent, and the capillaries were only very slightly dilated.

Discussion:

It has already been shown that an irregular rate of feeding may occur among a common stock of ticks while feeding under identical external conditions and on the same host. This variation was first thought to be due to the fact that certain of the ticks had tapped a blood vessel, and so gained an extra supply of nutritive fluid. This theory fitted very well with the fact that rapidly feeding ticks usually cause paralysis—any toxic secretion would be readily disseminated by such a position.

Studies from the previous experiment contribute the following data: Rapidly feeding ticks produce an acute inflammation in the underlying dermal tissues. Intense leucocytosis occurs around the blood vessels. The capillaries are very dilated, and a haemorrhagic area of haemolysed blood is usually present. Slow feeding ticks produce little or no change within the tissue. Capillary counts in both cases were similar.

These facts lend to an assumption that the inability of certain ticks to engorge rapidly during their feeding sason is not through an insuffciency of tissue blood. **It seems, rather, that the slow feeding ticks lack the power to produce sufficient disturbances within the tissue to cause a liberation of blood from the vessels.** Since the mechanical disturbance is very slight, and since the tick does not penetrate deeply enough to obtain blood from the capillary bed, it is entirely dependent upon the production of an edema and haemorrhage for its access to the blood fluid. It possibly produces these injuries by the elaboration of a powerful toxin, the evidence of which is suggested by the pathology of the tissues below the fast-feeding ticks.

The writer wishes to thank the Committee of Graduate Studies of the University of Alberta for their permission to present this paper, it

being a portion of a thesis which will shortly be submitted for the degree of M.Sc.

He is indebted to the Dominion Entomological Laboratory, Kamloops, for the use of material upon which the experiments are based.

NOTE: Recently, objects appearing to be symbiotic yeasts have been observed within the digestive epithelium of engorging ticks. It is probable that they play an important part in the assimilation of blood by the tick, and if so, may explain some of the irregularities that have been noted in the above-mentioned feeding rates.

THE CRUMENA OF THE COCCIDAE AND THE ADELGES

By A. D. Heriot
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The crumena is a tubular pocket or pouch, which acts as a receptacle for the long stylets which occur in several families of the Homoptera. In the majority of sucking insects the labium is as long as the stylets reposing in it, but the Coccidae, Adelges, Aleyrodidae, and the Psyllidae, all have stylets considerably longer than the labium, and until such time as the stylets are inserted into the host plant, their excess length has to be accommodated elsewhere.

The Psyllidae manage to do this by projecting the stylets forward from the base of the labium in a loop outside the body. In the other families the long stylets are doubled back into the tube-like crumena, which often extends to the posterior end of the abdomen, or in cases where the stylets are several times the length of the body, the crumena may be required to resolve itself into several loops.

This peculiar pocket was mentioned and named by Mark in 1876, but it is difficult to find anything in recent literature that gives a clue to its origin. It was described in 1928 by the Japanese author Kitao in "Notes on the Anatomy of **Warajicoccus,**" as a tubular passage having three walls or layers; an inner, weakly chitinized layer, a thinner middle hypodermal layer, and an outer layer consisting of an inconspicuous basal membrane. The only section of the scale crumena obtained in the laboratory at Vernon agrees with the above description. Unless, however, this organ is sectioned directly through the centre, the inner walls will be cut at more of a tangent than the outer wall, thus giving an impression of varying thickness. When the crumena is seen in dissection it appears to be composed of thin membranes of equal thickness.

In the present paper it is suggested that the crumena consists of the basal membranes or linings of the epithelial invaginations, which build up the stylets; that these membranes are brought down with the stylets to form a receptacle in the body for them. A difference between the crumena of the scale and that of the Adelges and mealy bugs seems to be correlated to a difference in the manner of bestowing the stylets in the crumena.

The main difference between the scale crumena and that of the Adelges and mealy bugs, is due to the fact that the latter insects cast away the inner tube or layer.

A brief description of the eclosion from the egg of **Adelges abietis** Kalt. shows how this is accomplished.

The eggs of this **Chermes** are deposited on the needles of Norway spruce, each egg being anchored by a pedicel. When the egg is in an advanced stage of incubation, the nymph within is observable with its long stylets rolled up on either side of the supporting frame of the mouth parts. As the nymph breaks out of the egg envelope and extricates itself, the stylets are then seen protruding from the labium, their tips being attached to the membrane of the egg envelope.

The stylets of the nymph are more than five times the length of its body. Hence it takes about half an hour for the long stylets to be entirely unrolled in the head and extruded through the labium. Until the stylets are fully extended and their proximal retorts clamped into the framework of the mouthparts no muscular action at their base seems possible, and the stylets are probably propelled forward by movements which must be attributed to the joint action of the labium and labrum.

The nymph, after straightening out its stylets, is some distance from the empty egg, but is still connected with this by the stylets. After a short pause of ten minutes duration the nymph walks away, leaving a membraneous tube attached to the empty egg.

During this pause the insect has retracted the stylets by means of the muscles at their base. Under the microscope first one mandible is seen to be retracted a short distance, then the other, the compound maxillae following suit. But whereas the mandibles are free, the maxillae are enclosed in a thin membrane which is broken off as the tips of the stylets disappear into the labium. This membrane is continuous with the egg membrane and cannot conceivably be anything else than the basal membrane of the maxillary invaginations. If these accompany the maxillary stylets it would be expected that the basal membranes of the mandibles should also accompany them. Dissection of the mealy bug during the moult, at a time when the stylets are fully extruded, indicates that the mandibular membranes are brought away from their invagination but do not pass out of the body. They appear to be crumpled up at the base of the labium ready to receive the stylets when they are retracted, thus forming the crumena.

The scale insect on the other hand does not extrude and retract the stylets through the labium. The stylets pass directly from their rolled position in the head into the labium and are then doubled back into the crumena, the maxillary membranes forming the inner tube of the scale crumena, while the mandibular membranes form the outer tube.

There is thus strong evidence that the crumena is derived from the same epithelial cells that build up the stylets. Increase in length of the stylets at each instar is therefore accompanied by a similar increase in the length of the material which forms the crumena. That this delicate organ is so seldom seen in section may be due to its degeneration and disappearance after it is emptied of the stylets.

It will probably be found that the new stylets of fresh instars of sucking insects are all enclosed in their respective membranes when leaving the maxillary and mandibular invaginations. There is some evidence that this is the case with the **Aphididae.** For instance, it is not uncommon in aphis-punctured tissue to find short projections which have hitherto been supposed to belong to the stylet sheath that the plant deposits around the stylet. It is more likely that these projections are the basal membranes which are sloughed off during penetration. Micro-photographs by other authors are indicative of this.

The basal membranes can only be used as a crumena in those insects in which the mouth parts are entognathous. In most of the species of the Homoptera the stylets issue out between the labium and labrum before entering the latter. In the Coccidae and Adelges the labrum and labium are so intimately in conjunction, as in the **Thysanoptera,** that they entirely enclose the stylets until these pass out at the tip of the labium.

A PRELIMINARY LIST OF PROTOZOA IN BRITISH COLUMBIA TERMITES

By J. K. Jacob
Vancouver, B.C.

The presence of protozoa in the lower termites has long been known and was first recorded by Lespes in 1856. Since then, many genera and species have been discovered. The opinion formerly held by some entomologists was that there was some correlation existing between the presence of protozoa and the condition of the sexual organs. Recent researches would indicate that the majority of protozoa are symbiotic and that their presence has nothing to do with the sexual organs.

To get a clear understanding of the relationships of protozoa and termites, it is necessary to present a brief description of the digestive tract of those which contain these symbionts.

Embryonically, the gut is divisible into three well-defined regions; the fore-intestine or stomodeum, the mid-intestine, and the hind-intestine or proctodeum. The stomodeum and the proctodeum are formed embryonically as invaginations of the anterior and posterior body wall respectively. The lining, therefore, of the fore- and hind-intestine is of the same material as that of the exoskeleton, that is, chitin. The mid-intestine arises independently of the body wall and thus lacks this chitinous lining.

The thin-walled pharynx merges into the oesophagus and a large crop, followed by the gizzard. Posterior to the gizzard the foregut protrudes into the cavity of the mid-intestine, forming a large oesophageal valve. At the anterior end of the mid-intestine, which is tubular and of uniform size throughout, are four short enteric caeca. At the junction of the mid- and hind-intestines are a number of Malphigian tubules. Posterior to these tubules, and in the enlarged portion of the hind-intestine, are present large numbers of protozoa. The larger members of this protozoan population appear to live in a symbiotic relationship with their host. In return for food, protection and a suitable medium in which to live, they render the termite a service in the digestion of cellulose which the termite is unable to perform alone.

According to Beall's (2) and my own collection the following are the three species of termites in British Columbia:— **Zootermopsis angusticollis** (Hagen), **Z. nevadensis** (Hagen) and **Reticulitermes hesperus** (Banks). In the first two of these species the digestive tract is as described above. The protozoa occurring in these are as follows, those I have found being indicated by an asterisk:

Z. angusticollis, the common damp-wood termite.

* **Trichonympha collaris** (Kirby).
* **T. campanula** (Kofoid and Swezy).
* **T. sphaerica** (Kofoid and Swezy).
* **Streblomastix strix** (Kofoid and Swezy).
* **Trichomonas termopsidis** (Cleveland).
* **Tricercomitus termopsidis** (Kirby).
* **Hexamastix termopsidis** (Kirby).
* **Hirmocystis termitis** (Leidy).

Z. nevadensis, the small damp-wood termite, is believed to have the same species of protozoa as **Z. angusticollis** but as yet I have not examined any of this species.

R. hesperus (Banks), the western subterranean termite.

* **Trichonympha agilis** (Leidy).
Microjoenia ratcliffei (Brown).
* **Torquenympha octoplus** (Brown).
* **Spironympha porteri** (Koidzumi).
S. ovalis.
* **Spirotrichonympha flagellata** (Grassi and Foa).
* **Holomastigotes elongatum** (Grassi).
Dinenympha fimbriata (Kirby).
Dinenympha sp.
* **Pyrsonympha major** (Powell).
P. minor.
P. granulata.
* **Hirmocystis termitis** (Leidy).

Protozoa are not present in newly-hatched termites. They are fed for some time on material (stomodeal food) regurgitated by the parents but after a moult or two, proctodeal food is added and finally constitutes almost the entire food supply procured from another individual. As there are no protozoa in the fore-intestine of the parents, first instar termites receive no protozoa in stomodeal food. There are protozoa in all the older instars. Nymphs, soldiers and adults contain the same species of protozoa, but they differ in total population and possibly relative proportion in the different forms of termites. Adults contain fewer protozoa than do nymphs of the seventh instar. The total number of protozoa found in immature termites varies with the time since the last moult and the nearness to the next moult.

A month before the moult, the intestine appears normal in every way and possesses its usual content of food material and protozoa. From three to four weeks before the moult, the termite enters a period of self-starvation, so that the food content of the intestine disappears but the protozoa remain. However, with their food supply cut off, the wood-eating protozoa gradually starve and disappear. Of these, the three species of **Trichonympha** go first followed by **Trichomonas,** so that

all four are completely absent before the moult occurs. Of the other three species of protozoa present, **Streblomastix** may, or may not remain through the period of the moult and **Tricercomitus** and **Hexamastix** always persist in the intestine.

As was said before, the fore-intestine and hind-intestine walls are lined with chitin which is continuous, through the mouth and anus, with the exoskeleton of the insect; with the shedding of the exoskeleton, these chitinous linings are also shed. Having thus renovated its digestive tract, the termite must reacquire a protozoan fauna. The above three smaller, non-symbiotic species of protozoa may remain in the gut through the moult; the larger species must be reacquired from other termites. The exact method of refaunation is not definitely known. That refaunation does not take place by anal contact with protozoa or faeces is shown by the careful studies of Andrew (1). Refaunation does take place readily by feeding on material containing protozoa. The methods by which the protozoa can be normally obtained for this feeding were not definitely determined in Andrew's experiments. Faeces do not contain protozoa in motile condition or in cysts, though there is some indication that cystoid forms of **Trichomonas termopsidis** and **Trichonympha campanula** exist in the intestine under certain unfavorable conditions. Feeding termites on faeces does not refaunate them. Cannibalism leads to a transfer of protozoa but it is not the only agency that achieves this result. Protozoa have been found in some instances on the unextruded pellet and in the first drop of intestinal fluid, hence the transfer of protozoa during proctodeal feeding may be one of the normal methods of refaunation. Andrew states that in mixed groups of faunates and defaunates where cannibalism was prevented and no stomodeal feeding or dropping of liquids was observed, proctodeal feeding on the part of both faunates and defaunates continued as usual, but refaunation was not accomplished, indicating that this may not be the most effective method of refaunation. In a few cases, liquid droppings were found to contain living flagellates, so that feeding on these and on fresh nest structures in which intestinal fluid is used as a cement may probably account in part for normal refaunations. By using recently moulted individuals it was determined that in the normal colony, refaunation has usually taken place by the third or fourth day.

Careful studies of the number of protozoa in a large normal nymph have shown approximately 25,000 **Trichonymphs** and about 500,000 **Trichomonas** (1).

Gregarines are also present in **Z. angusticollis** at least, and probably in **R. hesperus.** These are purely parasitic and are located in the anterior part of the mid-intestine. Their population varies in a single individual from one or two to several hundred (8). In the development, the immature gregarines are first attached to the intestinal wall in the crevices

between two groups of cells. Later the epimerite of the young gregarine is lost and then the protozoa becomes free. These parasites have no apparent effect upon the cells of the intestine, nor is the termite visibly affected by the presence of large numbers of gregarines. **Hirmocystis termitis** is the common species I have found in **Z. angusticollis. Kofoidina ovata** (Henry), a second gregarine, is recorded in **Z. angusticollis** from the State of Washington. As yet, this species has not been found in any of the British Columbia specimens.

Spirochaetes and bacteria are fairly common in the intestine. Some spirochaetes and bacteria are normally found adherent to the surface of the flagellates.

Some of the flagellates have internal parasites of their own, generally bacteria.

From this work, it can be seen that the protozoa in British Columbia termites are similar to those existing in similar termites of California.

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WINTER INSECTS IN BRITISH COLUMBIA.

Diptera: Cramptonomyia spenceri Alexander.

By. J. K. Jacob
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In my general insect collecting of the last few years I have paid particular attention to those insects occurring at the coast in winter, the season during which all Arthropods are supposed to be in hibernation. I find that the mildness of the coastal weather, at least in the vicinity of Vancouver, permits insects of several orders to be active, especially Diptera but also a few beetles, leaf-hoppers, psyllids and on one occasion two Hemerobiids.

This note, however, is concerned with the rare fly **Cramptonomyia spenceri** Alex., described in the bulletin of the Brooklyn Entomological Society, February, 1931, from specimens taken at Vancouver in 1930 and forwarded to Dr. C. P. Alexander by Prof. Spencer. This fly has proved of great interest to Dipterologists and it seems timely to add the known records of its capture. Since the first specimens were caught, additional ones were sent in a collection of Tipulids to Alexander, including some captured by K. Graham in Langley Prairie. All of these were females caught in March. My records of capture are from the University campus, February 1934, generally before noon when frost was on the ground. These captures were made along paths of the University forest. The flies were probably disturbed by my approach and were collected on the wing, the flight strongly resembling Tipulids, for which I at first took them. My specimens were all males. Apparently, then, the males emerge about a month before the females.

The latest information on the systematic position of this fly, as supplied me mostly by Dr. C. P. Alexander of the Massachusetts State College, is that they belong to the family **Bibionidae.** He explains that the genus **Cramptonomyia** diverges markedly from **Bibio** and **Dilophus** but there are several other aberrant genera that are invariably assigned to this family that makes it difficult to place **Cramptonomyia** in any group other than the **Bibionidae.** Such genera are **Plecia, Hesperinus,** and **Pachyneura. Pachyneura** he regards as the closest known ally of **Cramptonomyia.** This genus is found only in the northern Palaearctic region and is apparently not common in collections. Dr. F. W. Edwards of the British Museum is inclined to make an entirely separate family for **Pachyneura** but in the same group would also place the eastern **Axymyia** which is thought by Alexander as being a true Anisopodid. Dr. Crampton, who has made a very detailed study of these

genera, is inclined to believe that **Cramptonomyia** will at some time be made a family all of its own.

According to Alexander, a thorough study of both larval and pupal stages should go far in settling whether this is a true **Bibionid** or an isolated group. Up to the present, none of these stages has been found. The type specimen is in the Canadian National Collection, Ottawa. A single male has been forwarded to Dr. Edwards.

I wish to express my thanks to Dr. C. P. Alexander for explaining the systematic position to me and for his suggestions on the further study of this fly.

SOME FOOD PLANTS OF LEPIDOPTEROUS LARVAE

List 4

By J. R. J. Llewellyn-Jones
Cobble Hill, B.C.

In presenting this fourth list of food plants of lepidopterous larvae I should like again to express my thanks to those who have co-operated with me, either by forwarding, through the Secretary of our Society, records for inclusion in this list, or by giving valued advice as to the arrangement of the details herein set forth.

The initials of the person vouching for the information recorded are placed in brackets after the record.

The following is a list of abbreviations, marks, etc., used in this list.

H.B.L. H. B. Leech, Dominion Entomological Branch, Vernon.

W.G.M. W. G. Mathers, Dominion Entomological Branch, Vancouver.

G.R.H. G. R. Hopping, Dominion Entomological Branch, Vernon.

W.W.B. W. W. Baker, U.S. Bureau of Entomology, Puyallup, Wash.

J.R.J. J. R. J. Llewellyn-Jones.

An asterisk (*) denotes that the species has been mentioned before in the lists and that the information is either additional, or an amplification of what has been previously reported.

Anytus evelina hanhami Sm. Alder **(Alnus rubra** Bong.), willow, **(Salix hookeriana Barr.),** maple **(Acer macrophyllum** Pursh.), red-flowered currant **(Ribes sanguineum** Pursh.), wild cherry, **(Prunus emarginata** (Dougl.), bird cherry **(Nuttallia cerasiformis** T. & G.). (J.R.J.).

Apatela funeralis G. & R. Black hawthorn **(Crataegus brevispina** Dougl.) (J.R.J.)

***Arctia caja americana** Harr. Bracken **(Pteris aquilina** L. var.) (W.G.M.)

***Autographa californica** Speyer. **Doronicum** (in garden). (J.R.J.)

Cacoecia cerasivorana Fitch. Wild cherry **(Prunus emarginata** Dougl.) is, according to Dr. McDunnough, the usual food. Record from

Fernie on sp. of willow (**Salix**) rather unusual according to the same authority (H.B.L.)

Cacoecia rosaceana Harr. Alder (**Alnus rubra** Bong.) (W.G.M.)

Choreutis balsamorrhizella Busck. Skeletonizes the leaves of balsam root (**Balsamorrhiza sagittata** Nutt.) (H.B.L.)

Coniodes plumigeraria Hlst. Garry Oak (**Quercus garryana** Dougl.) (J.R.J.)

Coptodisca arbutiella Busck. Arbutus (**Arbutus menziesii** Pursh.) (W.G.M.)

***Diacrisia pteridis rubra** Neum. Juneberry (**Amelanchier florida** Lindl.), plantains (**Plantago major** L. and **P. lanceolata** L.). (J.R.J.)

Enargia decolor Wlk. Aspen (**Populus tremuloides** Michx.). (H.B.L.)

Eupithecia vancouverata Tayl. Arbutus (**Arbutus menziesii** Pursh.) (J.R.J.)

***Graptolitha georgii** Grt. Apple (garden varieties). (J.R.J.)

Gracilaria alnivorella sanguinella Beut. Alder (**Alnus rubra** Bong.) (W.G.M.)

Griselda radicana Wlshm. Douglas fir. (**Pseudotsuga taxifolia** (Raf.) Sudw.). (W.G.M.)

***Halisidota masulata angulifera** Wlk. Alder (**Alnus rubra** Bong.) (J.R.J.)

***Hyphantria textor** Harr. Black hawthorn (**Crataegus brevispina** Dougl.). (J.R.J.)

Litholomia napaea umbrifasciata Blackm. Willow (**Salix hookeriana** Barr.) Juneberry (**Amelanchier florida** Lindl.). (J.R.J.)

Lotisma trigonana Wlshm. Berries of salal (**Gaultheria shallon** Pursh.) (H.B.L.) Evergreen huckleberry (**Vaccinium ovatum** Pursh.). (W.W.B.)

Luceria tranquilla Grt. Rolls leaves of blue-fruited elder (**Sambucus glauca** Nutt.) Later the leaves are skeletonized. (G.R.H.)

***Lycophotia margaritosa** Haw. Spear thistle (**Cirsium lanceolatum** (L.) Scop.) (J.R.J.)

Oidaematophorus occidentalis Wlshm. Balsam root (**Balsamorrhiza sagittata** Nutt.) (H.B.L.)

Orthosia pacifica Haw. Garry Oak **(Quercus garryana** Dougl.), **willow (Salix scouleriana** (Hook.) Barr.), (J.R.J.)

Paraptera danbyi Hlst. Garry Oak **(Quercus garryana** Dougl.) (J.R.J.)

Pseudohazis eglanterina Bdv. Ocean spray **(Spirea discolor** Pursh.) (J.R.J.)

***Schizura unicornis** A. & S. Roses (garden varieties), Japanese cherry (flowering) **(Prunus cerasus)**... (J.R.J.)

Xanthorhoe defensaria Gn. Willow **(Salix hookeriana** Barr.) Alder **(Alnus rubra** Bong.) red-flowered currant **(Ribes sanguineum** Pursh.), maple **(Acer macrophyllum** Pursh.) (J.R.J.)

Xylena nupera Lint. Wild cherry **(Prunus emarginata** Dougl.) Juneberry **(Amelanchier florida** Lindl.) willows **(Salix hookeriana** Barr., **Salix scouleriana** (Hook) Barr.), Alder, **(Alnus rubra** Bong.), red-flowered currant **(Ribes sanguineum** Pursh.), Ocean spray **(Spirea discolor** Pursh.), Maple **(Acer macrophyllum** Pursh.), Roses **(Rosa gymnocarpa** Nutt., and **Rosa nutkana** Presl.)
N.B. The larvae of this species have a strong tendency to cannibalism. (J.R.J.)

Xylomyges crucialis Harv. Garry Oak **(Quercus garryana** Dougl.) (J.R.J.)

CORRECTION

In a short article published in the Proceedings of the Entomological Society of British Columbia, No. 28 (1931) p. 19-20, the parasitic fungus concerned was reported as a species of **Stigmatomyces.** More recently, material has been submitted to Dr. David H. Linder, of the Herbarium of Cryptogamic Botany, Harvard University. Dr. Linder identified the species as **Sterigmatomyces entomophila** (Pk.) Thaxter.

Hugh B. Leech.

A REVIEW OF TICK PARALYSIS IN CATTLE IN BRITISH COLUMBIA

With Notes on Several New Cases

By T. K. Moilliet
Dominion Entomological Laboratory, Kamloops, B.C.

History

Until 1930, tick paralysis was not considered of great importance to cattle raising in British Columbia. Several isolated cases had occurred from time to time, but no outbreak involving much loss had occurred.

From the records of Hadwen [3], Bruce [1] and Hearle [4] it appears that this disease, caused by the bite of the wood tick, **Dermacentor andersoni** Stiles, has occurred sporadically nearly all over the dry belt of British Columbia and north-western United States [5]. The first case in which cattle died was reported to Dr. Bruce [2] in 1922 by T. A. Moilliet of Vavenby. In this case two head of young cattle died April 16, 1922. They had been imported the previous fall from Alberta.

In the North Thompson valley, ticks have been occasionally paralysing people, dogs and sheep for over twenty years, and during the late 1920's there were a few more cases among cattle at Vavenby, B.C. In the worst recent case the cattle were imported from Alberta.

In the Nicola valley, cattle have been raised on a large scale since 1870, and by 1888 there was already much overgrazing. The large cattle owners had practically no trouble with ticks, although humans, dogs and a few sheep had occasionally died from tick paralysis in the district.

In April 1930, a "plague of ticks" occurred at Nicola, in yearling steers, in a herd of 900 head owned by the Douglas Lake Cattle Co. This was reported by Hearle [4] in the proceedings of the B. C. Entomological Society for 1933, and will be used here for comparison. This was the first severe outbreak among cattle recorded in the province. Over 11% of the herd was affected, with a mortality of 7%.

New Cases

In 1934, when one of the riders for Guichon Bros. at Quilchena, in the Nicola valley, was interviewed, he mentioned that several cases of tick paralysis had occurred that April in yearling heifers in a field (lot 207 and beyond) which runs from two to four miles from Quilchena up the south-west side of the creek. He had saved these animals by picking

off the ticks. Outside of this, there had been no trouble during all the years the field had been grazed.

On March 8, 9, and 11, 1935, 638 yearling steers were dehorned and, after staying in feed lots until April 2, were turned out on the field referred to in the above paragraph. The cattle were looked over on April 12 and appeared to be doing well. On April 17, however, a rider found 100 down with ticks, several dead and dying. At once all available men were summoned and set to clipping the animals' necks, removing ticks and applying carbolic acid to the bitten areas. The whole herd was rounded up, driven to the ranch and there treated. On the drive to the corral many staggered and fell and had to be brought in in wagons. The owner stated that at least 200 were affected badly enough to fall.

As the animals went through a chute, large numbers of ticks were removed and a mixture of one part creosote, two parts coal oil and one part raw linseed oil was rubbed along the neck and back to kill the remaining ticks and act as a repellent dressing. The herd was then moved to a different part of the range.

Most of the animals recovered within a few hours of de-ticking. Five head, including a two-year-old, were dead before treatment began (and from the ground near their bodies a good series of fed female ticks was recovered by the writer on April 26). Two animals had drowned in a small creek. Seven head which did not recover immediately on the range were brought in by wagon to the barn. By April 28, five of these remained unable to rise. One of these died on April 28, and an autopsy made by J. D. Gregson and the writer showed that pneumonia had probably been the cause of death. Mr. Gregson attempted cultures from the lung and spinal fluid, and injections into two guinea pigs and a white mouse, but they resulted in nothing of value. Blood samples taken from the four remaining sick cattle were tested by Dr. R. R. Parker of the Rocky Mountain Spotted Fever Laboratory at Hamilton, Montana, for both **Brucella abortus** Bang and **Bacterium tularense** McCoy & Chapin, but with negative results. Both of these diseases were involved in an outbreak of paralysis of cattle by **Dermacentor occidentalis** Neumann in California [6].

In 1934, it was learned from Mr. C. H. Ross, rancher, of Baynes Lake in the East Kootenay district, that he had had severe losses that spring. During April 1934, out of a herd of 91 he lost 16 head, ranging in age from six months to six years. The mortality occurred only among cattle imported that spring from Alberta. There had been a few animals affected in previous years and large numbers of ticks were involved, but no losses.

Also in April 1934, Guichon Bros. of Quilchena reported they had lost 12 cows in a field north of the east end of Nicola lake, but it is not known that ticks were the only factor responsible.

Comparison of Two Serious Outbreaks

The following tables give a synopsis of the variable and constant factors in the two principal outbreaks cited, those of Nicola, 1930, and Quilchena, 1935.

Factors in which there was little or no variation:

Type of area: Bunchgrass with yellow pine, Douglas fir, saskatoon, rose, chokecherry, willow, aspen, etc.
Rodent tick hosts present: Presence of rock bluffs, abounding in red squirrels, chipmunks, mice, packrats, coneys, groundhogs, blue grouse. Elevation 2200 feet to 3500 feet.
Rodents increasing: Apparently, but data uncertain.
Length of time grazed: Over 65 years.
Previous trouble: One or two cases in recent years.
Breed of cattle: Hereford.
History of herd: Local bred.
Age: Yearling.
Sex: Steers.
Peak of tick activity: April 17.

Factors showing some variations:

	1930	1935
Season:	One of the earliest springs, following light snowfall and very cold winter.	One of the latest springs following heavy snowfall and fairly cold winter.
Weather:	Many warm days and cold nights from April 1 to 20.	Warm from April 9 to 14, cold nights.
Exposure of field:	Western	Eastern
% number of cases to go down:	11.1%	31%
% mortality of those affected:	65%	13%
% affected by blowflies:	65%	½%
Number in herd:	900	638
Number affected sufficiently to go down:	100	200
Mortality:	65	26

Discussion

From the above account, as well as from other data available on tick paralysis in other animals and man, it is clear that one of the most variable factors is the power of ticks to paralyse. It is paralleled somewhat by the rise and fall of the virulence of bacteria or virus in disease epidemics.

There can be little doubt, however, that **D. andersoni** Stiles, the only tick involved in British Columbia, is increasing. This is brought about by two interdependent factors:

(1) Since the country was settled, domestic animals have probably more than compensated in abundance for any reduction in the larger game animals, especially as they may have less natural resistance to infestation than wild animals.

(2) Owing to the fact that it is a three-host tick and requires the blood of rodents in its first two stages, the increase of members of this order in a district is bound to be a very important factor in its increase. There is no doubt that this condition has been fulfilled in many of the districts where this tick is becoming such a serious pest. The Columbia ground squirrel **(Citellus columbianus columbianus** Ord) in the moister sections and the groundhog **(Marmota flaviventris avara** Bangs) in the drier parts of this tick's range are the two species which are most noticeably increasing. It is difficult, however, to get reliable data on any of the other species, even the snowshoe rabbit.

An interesting feature of the disease in cattle is the apparent inability of the animals to straighten the front legs, especially the right. After they can stand they are often unable to walk, except on the front knuckles, for over a week. Whatever poison is involved apparently shortens the cords of the limb as well as paralysing the nerve. Cattle usually fall on the right side with the head buckled under.

It is of interest that neither tularaemia nor Bang's disease was present in the Quilchena outbreak. No tests for these diseases were made in other B. C. outbreaks.

Immunity

Prior to 1930, it was noticed that usually it was imported stock which were most affected; especially in older stock, as in the cases at Baynes Lake and Vavenby, and at first sight the Nicola valley outbreak appears to discredit this. Still it must be remembered that these young cattle had sires which were pure-bred, and protected from ticks, that they were under one year old, and had just been weakened by dehorning. Most range calves are born during the latter part of the tick season, late May and June; thus they may be slightly tick infested during their first

month of life. This would not have been true during May 1934, however, since the writer found it impossible to collect any ticks on the Nicola range at that time. When these points are considered, it appears probable that there may be an acquired immunity to the disease in cattle. An hereditary immunity could hardly be involved, since there has not been time for this evolution to take place.

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6. Parker, R. R., Brooks, C. S. and Marsh, H., "The Occurrence of **Bacterium tularense** in the Woodtick **(Dermacentor occidentalis)** in California," U. S. Pub. Health Rep., Vol. 44, No. 22, pp. 1299-1300, May 31, 1929.

THE LIFE HISTORY AND HABITS OF THE RED-LEGGED HAM BEETLE "NECROBIA RUFIPES" (De GEER)

By. H. F. Olds
Plant Inspection Office, Entomological Branch, Canada Department of Agriculture, Vancouver, B.C.

The life-history of **Necrobia rufipes** (De Geer) varies considerably according to climatic conditions, but in its more favoured habitats, De Geer [1] records its description as follows:—"The adult beetle is 4.5 mm. long, iridescent peacock green or steel blue, with the bases of the antennae and the legs red. The head and prothorax are covered with fine hairs with the elytra finely striate. The eggs are a dirty white. (I was not able to get any at this season to include in the mount shown.) The larvae are a pale brownish yellow, with the head and thorax darker, somewhat hairy and approximately 10 mm. long."

L. O. Howard [2] says the average life cycle lasts from 30 to 45 days. Temperatures would be responsible for the variations in time. He also states that the adults may last as long as 14 months and lay as many as 2100 eggs.

During the course of our inspection duties covering imported plant products, probably no insect makes its appearance more often than the red-legged ham beetle. As a cosmopolitan feeder it has few equals. This will account for its wide distribution. From reports in "The Review of Applied Entomology," from Germany we have records of this insect infesting egg-yolk, tapioca, and the raw cassava root which is used in the manufacture of tapioca; in Ceylon and Samoa, infesting copra, cocoa beans, coffee, nut meats, hides, etc.; in Java, dried bananas, and in the Southern States we have records where considerable damage has been done to cured hams and bacon. De Geer records the fact that the larvae died when fed on Chinese egg yolk. (I am not at all surprised at that). But strange to say the adults thrive on it, although no pairing occurred and no eggs were laid while feeding on this product.

In the warmer climates this insect could become one of economic importance, but probably will never be considered any more than a storage pest in Canada, and, provided we see that imported products so infested are fumigated before being placed in storage, that phase may also be obviated.

It is interesting to note that both the adult and the larvae are considered somewhat predaceous. De Geer (Rev. Applied Ent.) reports the adults as attacking the Cheese Skipper, **Prophila casei** (Linn.) However, I believe I should just as soon have the cheese skippers on my cheese as **Necrobia rufipes.**

In Samoa this beetle is known as the copra beetle, probably due to the fact that wherever copra is stored, and particularly where it has become slightly rancid, these beetles may be found feeding.

Just recently, we examined three cargoes of copra which were docked here for trans-shipping, and all these were badly infested with the **Necrobia** beetle. It might interest the meeting to know how we handle situations of this nature.

In warm weather this beetle is quite active and will crawl for considerable distances. However, weather conditions were quite cold when these consignments arrived, and this drove most of the beetles into the sacks of copra. By having all other products removed to a safe distance, and after the copra had been re-shipped, by sweeping and spraying the space carefully, practically all danger of spreading this pest to other products was obviated. In regard to these clean-up measures, we generally receive very good co-operation from the transportation companies.

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(2) L. O. Howard. U.S.D.A. Review of Applied Entomology, 1926, vol. 14, pp. 387-437 and 525. 1927, vol. 15, p. 325. 1928, vol. 16, pp. 100-1 and 541-42. 1929, vol. 17, p. 600. 1931, vol. 19, pp. 21-230-585.

THE TERMITE SITUATION IN BRITISH COLUMBIA IN 1936

By. G. J. Spencer
University of British Columbia, Vancouver, B.C.

For the past ten years I have collected Termites or White Ants in this Province, from Tofino and Long Beach on the West coast, from Mount Tolmie outside of Victoria and at Nanaimo, on Vancouver Island; on the mainland and in the Gulf, from Van Anda on Texada Island and from all around Vancouver. In the Interior I have taken them from Kamloops and from half way between Lytton and Lillooet. Mr. Hugh Leech sent me a collection from Salmon Arm.

In British Columbia there are two species and probably a race of one of them constituting a third species. These are:

Zootermopsis angusticollis Hagen, the Coast or Wet Belt form. I have taken this on Texada Island and all around Vancouver and New Westminster. Workers are about one-half inch long, and winged ones, about one inch long with their wings.

Zootermopsis nevadensis Banks, on the west coast of Vancouver Island and at Nanaimo. It is the same size as the previous species.

Reticulotermes hesperus Banks, the dry belt or underground termite. This is less than half the size of the two preceding forms; workers and soldiers are white and alate forms, black. Taken at Kamloops, Lytton and Salmon Arm. I think it is this species which has been reported as far north as Quesnel.

Up to a year ago, I had not encountered actual commercial damage from these insects and considered this freedom due to the large amount of waste lumber lying in all directions in surrounding woods and on bare lots in the city. However, in the autumn of 1935, I received a call from a large abattoir in South Vancouver where much damage had been done to the underpinnings of the landing approach and platform and to the animal stables. All affected wood had to be replaced by concrete and creosoted timbers, and the cost was considerable, amounting, in the case of the creosoted timbers alone, to over seven hundred dollars. Hunting for the source of this infestation, we found that the abattoir adjoined the yards of an abandoned lumber mill, whose extensive site in the low-lying area near the river had been paved with heavy timbers which were lying everywhere in various stages of decay and, at time of our inspection, were being overgrown by grasses and alders. These timbers were heavily populated by **Z. angusticollis,** enough to re-infest all large buildings in every adjacent direction.

The second complaint came from a private dwelling in South Vancouver and was investigated by Mr. Kenneth Jacob, one of our graduate

students who is working on the biology of Termites in this Province. He found the sills and sleepers of the house to be heavily infested and practically destroyed by this same insect.

In January, 1936, I found this species infesting remains of stumps under the floor of the University gymnasium, left lying there by the contractors instead of being hauled out and burnt. This trash was at once hauled out and destroyed by University authorities.

Then in February, I received an urgent appeal from the Manager of the Powell River Paper Company, whose townsite manager had reported that the underpinnings of many buildings in the townsite were being destroyed by Termites. Here again, the same species was concerned.

Since then, Mr. Jacob has assembled several more records around Vancouver.

Two points have come up in connection with the attacks of **Z. angusticollis** around Vancouver which are not normal and which must be taken into account in building plans in future. The *one* is the fact that I have found them excavating *DRY* timber resting against cement. While the moisture content of the wood in question was not determined at the time, in no sense could it have been called damp; rather it would have been described as bone dry. The *other* point is that they can become established in timber above ground, without tunnelling up from the ground. In 1932 I found a deeply-checked telephone pole infested some 4 to 5 feet above ground level. In 1936 the condition of the pole necessitated its replacement and company workmen gave it to the owner of the house for firewood. This man sawed it into blocks for burning and, at my request, kept careful watch of the location of the termites in it. He reported that the timber below the point of infestation was perfectly sound as I had suspected, and that the infestation did not begin until some 4 feet above the sod in which the pole had stood. The attack must have been started by termites flying into the pole which had checked well above the ground and this fact, unusual in its occurrence, warrants additional precautions in future.

These records go to show that at least **Z. angusticollis,** the damp climate termite, is spreading its attacks in the Vancouver district from waste lumber to timbers placed on or near the ground in private dwellings and in certain factories, that it is capable of serious damage to timber, and that it may be expected to extend its attacks to local buildings in future.

A campaign with the necessary publicity seems indicated, to warn citizens of the danger to be expected from termites in British Columbia.

THE MENACE OF RAT PARASITES IN VANCOUVER IN 1936

By. G. J. Spencer
University of British Columbia, Vancouver, B.C.

Ever since the depression hit Vancouver in 1930, and the city fathers were forced to curtail the number of garbage collections to once in two weeks, and more recently to once a week, the Norway or sewer rat, **Rattus norvegicus** Erxleben, which has spread with commerce all over the world, has increased greatly and has spread practically all over the city. At the University, it occurred first in 1933, swarming out from the Endowment Lands garbage incinerator just west of the University on Marine Drive and has at times since then occasioned considerable loss by chewing up bulbs and sprouting shoots in the Botanical gardens. Moreover, it has occurred in some of the laboratories of the University.

This infestation at the University, isolated as it is by nearly two miles of forest-covered land, is nothing compared to the swarms of rats which have been reported from time to time in lanes, around garbage cans and in stores in the city. Elevator and feed-mill men have also complained about the vastly increased numbers of rats.

Now this rat carries with it the rat flea **Ceratophyllus fasciatus** Bosc., the rat louse **Polyplax spinulosa** (Burmeister) and the rat mite **Liponyssus bacoti** Hirst, not necessarily all together, but at one time or another. I have collected all three from rats in Vancouver. The parasites are not latent creatures merely sucking blood from their hosts; they serve as reservoirs of other parasites. The flea carries a trypanosome, **Trypanosoma lewisi** Minchin which occurs in the black, the brown and some wild rats the world over. This protozoan happens to be relatively harmless so far as we know and is probably carried by the rat louse as well. The flea also carries a very common tapeworm of rats and mice **Hymenolepis diminuta** (Rudolphi) which sometimes occurs in human beings also, chiefly in children. It is also concerned in the transmission of bubonic plague, and since this rat flea bites man when hungry, it has had much to do with the spread of the disease. Moreover, rats carry another flea of Asiatic origin, **Xenopsylla cheopis** Rothschild, the true plague flea, which has been spread to many parts of the world by these rodents, including many of the large sea-ports of the United States, especially the southern ones. I have not collected it, so far, from rats in Vancouver but it will probably turn up here sooner or later. I am on the look-out for it.

However, it is with the rat mite, **Liponyssus bacoti** Hirst especially, that this note is concerned. This winter and spring (1935-36) I was called into consultation by certain authorities over an outbreak of mites

in a large store on Hastings street in Vancouver where most of the employees, chiefly young women, were being bitten by mites. I collected samples and found that they were **L. bacoti** Hirst, the same as were sent to me previously by the authorities who first reported the outbreak to me. In the store, I found that the susceptibility of individuals to attacks varied considerably, but most girls complained of being bitten on the arms and around the ankles. The main source or centre of the outbreak was in cartons of merchandise in the basement where rats had made their nests; there were very few under goods exposed for sale on counters. The mites appear red when filled with blood and are then about 2 mm. long. Their excrement in and around the nests of the rats resembles a concentration of fly specks. From these breeding centres, the mites had spread to all parts of the building concerned, crawling freely and rapidly in all directions at night and generally hiding by day in cracks and crevices.

The itching and irritation to humans from the bites of the mites, lasts about two days on sensitive people and only a few hours on less susceptible ones. Fortunately, the mites do not appear to carry any disease as do the rat fleas.

As far as I can determine, this is the first record of this trouble in Canada. In the United States it has been reported by Dr. Bishopp who came across outbreaks in 1920 and 1921 in Dallas, Fort Worth and Houston, Texas, and in a small town in Mississippi. Previous to this, it had been reported in outbreak form in New South Wales and in Western Australia, Egypt, Argentina and Abyssinia. In every instance recorded, the trouble from mites followed a heavy infestation of rats and occurred more in stores and places of business than in private dwellings.

The essence of mite control is to eradicate the rats—generally a difficult problem but a first essential. It takes about ten days or two weeks, after the rats have been killed off, for the mites to disappear.

Shortly after recording the above, another severe infestation of mites in a large office building in town was reported to me. I was unfortunately unable to inspect the building myself and the specimens sent up for identification in an envelope were too battered to examine, but the report of conditions and the attacks on employees coincided exactly with the first infestation, so I feel convinced that the same species of mite was concerned. In this second case, a commercial exterminator was called in who treated the building extensively and the trouble soon subsided.

INSECTS (OR NEAR RELATIVES) OF ECONOMIC IMPORTANCE RECENTLY NOTED IN BRITISH COLUMBIA

One of our members, Mr. A. D. Heriot, has pointed out the value of records of economically important insects, or near relatives, of recent discovery in British Columbia. Such lists have been published in the Proceedings from time to time and have been most useful for reference. The Secretary, therefore, has compiled the following list from reports sent in by various members. The name of the member, or other person reporting, appears in parentheses at the end of each citation.

Orthoptera

Gryllus domesticus L., Vancouver, Oct. 1934 (J. K. Jacob).

Periplaneta australasiae (Fabr) Trail, 1935 (H. B. Leach from P. A. Watts).

Stenopelmatus longispina Brunner, Vancouver, in wholesale fruit section, probably imported in California fruit. (G. J. Spencer from A. F. Barss, University of B.C.).

Thysanoptera

Taeniothrips gladioli M. & S. (Gladiolus thrips), first appearance, 1933, now over lower Fraser Valley (R. Glendenning).

Taeniothrips inconsequens (Uzel), Vernon district, 1931, on pear (A. D. Heriot).

Homoptera

Chermes abietis L., Vernon district, 1934, on Norway spruce (A. D. Heriot).

Chermes cooleyi Gill., Vernon district, 1934, on Douglas fir and Engelmann spruce (A. D. Heriot). This species has been present for a long time.

Pineini (Chermes) coloradensis Gill., Vernon district, 1934, on lodgepole pine and yellow pine (A. D. Heriot).

Dialeurodes chittendeni Laing, Victoria, April 16, 1934, host Rhododendron (W. Downes).

Empoasca abbreviata De Long, Vernon district, 1932, on cover crop alfalfa (A. D. Heriot).

Gossypia spuria (elm scale) Vancouver, 1933, European and American elms became heavily infested. Mode of introduction unknown (R. Glendenning).

Pseudococcus maritimus Ehrhorn, Cowichan, April 1934; host passion vine and many greenhouse plants (W. Downes).

Typhlocyba pomaria McAtee, Vernon district, 1932, on apple (A. D. Heriot).

Coleoptera

Byturus unicolor Say, Grand Forks, 1935, a Dermestid beetle breeding in raspberries (M. H. Ruhmann).

Criocerus asparagi L. (asparagus beetle), Vancouver, B.C., June 1, 1933 (J. K. Jacob), Vancouver, 1934, (W. G. Mathers), 1935 (R. Glendenning and R. A. Cumming). Present range unknown.

Hylastinus obscurus Marsh (clover-root borer) Saanichton, Sept. 20, 1935, host clover (W. Downes).

Mezium americanum Lap., Victoria, July 17, 1934, in stored products (W. Downes).

Phloeosinus sequoiae Hopk., Vancouver, 1934, damaging Lawson's cypress in a nursery (R. Glendenning). A native of B.C. quite common in western red cedar (G. R. Hopping).

Tachypterellus quadrigibbus Say (apple curculio) Salmon Arm, attacking young pears (E. R. Buckell).

Lepidoptera

Depressaria herachana (parsnip webworm) Coldstream, Vernon district, 1935, apparently the first record for this region (E. P. Venables).

Dichomeris marginella Fab., Victoria, June 15, 1934, host, spiny junipers (W. Downes), Summerland, 1934, defoliating junipers (R. Glendenning); Vancouver, 1934, on spruce in a cemetery (R. Glendenning).

Laspeyresia nigricana (pea moth). This insect became a pest of serious importance in 1933 in the Sumas area. Its presence in the Province before is doubtful.

Laspeyresia piperiana Kft. (yellow pine-cone moth), May 11, 1935, Vernon district (A. A. Dennys).

Hymenoptera

Coelopisthia nematicida Pack., Fernie district, 1934, an important parasite of Lygaeonematus erichsonii Hartig (European larch sawfly) (G. R. Hopping).

Lygaeonematus erichsonii Hartig, Fernie district, first reported in 1933, but evidently present for at least four years previously, host Larix (G. R. Hopping, through the B.C. Forest Service).

Mesoleius tenthredinis Morley, shipments from Eastern Canada liberated in 1934. Field recoveries made in 1935, host European larch sawfly (R. Hopping, H. B. Leech).

Prospattella aurantii (Howard) Vernon district, 1933, host Aspidiotus ostreaeformis Curtis (A. D. Heriot).

ENTOMOLOGICAL SOCIETY OF BRITISH COLUMBIA
REPORT OF THE SECRETARY-TREASURER
for the Year Ending February 28, 1936

Herewith, I beg to submit this report of the activities of this Society for the past year.

Finances

The present bank balance as indicated and audited is $21.25. Since the last audit, two numbers of the Proceedings have been paid for and $55.00 has been retired to the reserve fund. The grant from the Provincial Government has not been received to date but the indications are that it will be forthcoming.

The establishment of the reserve fund is particularly gratifying. It is felt that this is a step in the right direction and possibly the only means whereby this Society may go forward instead of standing still.

Proceedings

It is certain that if this Society is to have the prestige in the Entomological World which it deserves, the goal to be desired is to issue the Proceedings quarterly. The first step towards the attainment of this will probably be to issue two times a year as soon as finances permit.

Membership

At the present time, the number of members in good standing is thirty-six. There are at least four new members to be considered at this meeting.

Library

A list of the accessions to the library which have been received during the year recently has been mimeographed in the President's office and this list is available on request. The Secretary is preparing an index of all of the articles which have appeared in the Proceedings from the beginning. The intention is to mimeograph these and make them available to members. Any suggestions as to the method of indexing will be welcomed.

Respectfully submitted,
GEO. R. HOPPING,
Hon. Secretary-Treasurer

Vernon, B.C.
February 24, 1936.

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Vice-President (Coast).....G. J. Spencer

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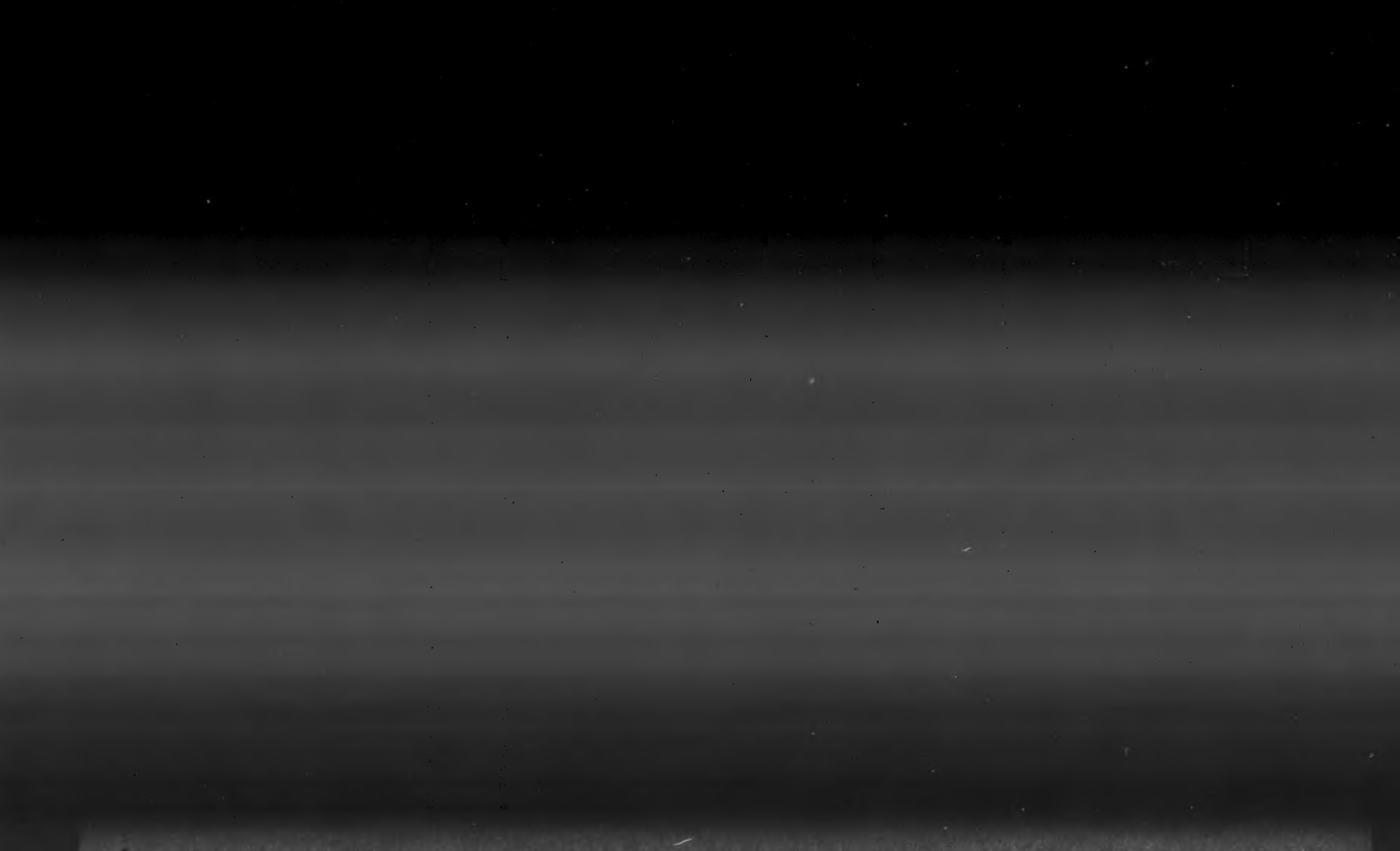
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